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MINIMUM WAGE RATES AND UNEMPLOYMENT IN THE NETHERLANDS

BY

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1 INTRODUCTION

During years of recession, many economists blame downward wage rigidity for the growth of unemployment. In The Netherlands and other Western countries it has been suggested that existing minimum wage regulations might be an important source of such a rigidity. It has become a matter of debate whether the benefits of minimum wage regulations are not outweighed by their drawbacks because the level of the minimum wage rate – as to be paid by the firm – is too high.

On the one hand of course, the main purpose of minimum wage rates is to raise incomes of employees, in particular those with low productivity. On the other hand, the minimum wage barrier could prevent employers from hiring these often young and unskilled or unexperienced workers, in which case – since unemployment benefits are generally lower than (corresponding) wages – a negative effect on income results. And even if this effect is small, a negative impact on the individual's well-being is possible, since recent empirical studies suggest that many workers prefer employment to unemployment, even if the incomes associated with both states are equal (see, *e.g.*, Kapteyn *et al.*, 1988).

Dutch studies show that there is a relative surplus of potential low wage earners – *i.e.* unskilled and inexperienced people – among the unemployed in The Netherlands (see Van Schaaijk, 1984) and that the growth of unemployment is also strongly concentrated in this group, contrary to the development in the U.S. (see CPB, 1986 and Frijns and Van Schaaijk, 1987). The share of minimum wage earners among employees fell from 9.9% in 1974 to 6.5% in 1983. These facts taken together suggest that firms are trying to get rid of workers with low productivity.

In this paper a micro-economic approach, related to the work of Meyer and Wise (1983a,b) in the U.S., is followed to analyse the impact of minimum wage

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regulations on the Dutch labour market. The minimum wage law is the only friction in the labour market that is taken into account and therefore the only cause of involuntary unemployment explicitly incorporated in the model.

In Section 2, a limited dependent variable model based upon a two-equations reduced-form model of the labour market is presented and estimated with data from a cross-section of Dutch males and females in 1984. Although the estimation results do not seem unreasonable, they also reveal some important shortcomings of the model. In Section 3, a first step is made towards a structural model of the labour market. The reduced form equation for labour market participation is replaced by a neoclassical labour supply equation. Although the specification of labour supply is kept rather simple, simultaneous estimation of wage and supply equations is very complicated because of the presence of non-convex budget sets. For this reason, the labour supply equation is estimated separately. In Section 4, some simulations are performed based upon the wage equation in Section 2 and the structural labour supply equation in Section 3. Concluding remarks are in Section 5.

2 A REDUCED-FORM MODEL

In this section we present a model which is closely related to the two-equations model introduced by Meyer and Wise (1983a). The model essentially consists of a wage equation and an equation to explain labour market participation. The wage equation states that, in absence of minimum wage regulations, the hourly before-tax wage rate equals the worker's marginal net productivity, which depends on observed and unobserved personal characteristics:

$$\log W_t^* = \mathbf{X}'_t\alpha + \varepsilon_{1t}, \tag{1}$$

where W_t^* : the hourly before-tax wage rate for individual t in absence of minimum wage regulations,

$\mathbf{X}_t$ $=(X_{t1}, X_{t2}, \ldots, X_{tm})'$: vector of explanatory variables, mainly individual characteristics of individual t (and including a constant term),

α $=(\alpha_1, \alpha_2, \ldots, \alpha_m)'$: vector of parameters,

ε_{1t} : error term, representing unobserved characteristics of individual t or errors in the observation of marginal productivity by the employer.

Equation (1) implicitly implies that the wage elasticity of labour demand for individual t equals $-\infty$ at W_t^* and 0 elsewhere. This seems an unrealistic assumption, since several Dutch studies suggest labour demand elasticities of approximately -0.8 (see *e.g.* Kuipers, 1984, or Theeuwes, 1988, for an overview). However, because W_t^* varies across individuals, the implied aggregate elasticity may still be realistic; its value depends on the parameters α and the variance of ε_{1t}. The equation has a *ceteris paribus* character in the sense that an individual's situation is described, taking the composition of the rest of the labour force as given. For instance, if more people with similar characteristics are hired and if returns to scale are decreasing, marginal productivity will shift downward and equation (1) does not take this into account. For this reason, the model might overestimate the effect of lowering labour costs on employment.

The wage rate which is actually paid will not always equal W_t^*, due to several institutional constraints such as minimum wage regulations, union agreements, fixed periodic salary raises, *etc.* In this model only minimum wage regulations are taken into account. The minimum wage rate for individual t is denoted by M_t.

If W_t^* exceeds M_t, then the minimum wage law is not binding and the before-tax wage rate actually paid, W_t, equals W_t^*.

If W_t^* is less than M_t, three outcomes are possible. Which outcome occurs is indicated by an index variable I_t.

Firstly, the possibility exists that the minimum wage law does not apply (in The Netherlands, this is the case for a small number of part-time jobs) or the employer finds some way to evade it ($I_t = 1$).

If the minimum wage law does apply, the employer can decide to raise the wage to the minimum level ($W_t = M_t$; $I_t = 2$) or not to employ the worker ($I_t = 3$), in which case, of course, no wage rate is observed.

We assume that these three events occur with (conditional[1]) probabilities $P1$, $P2$ and $P3 = 1 - P1 - P2$ respectively.

The second equation is a reduced-form equation for labour market participation. The decision whether or not to participate on the labour market may be assumed to depend on individual characteristics, the (after-tax) wage rate, unearned income, and unemployment benefits. In the linearised reduced-form equation we use in this section the wage rate is eliminated and unearned income variables are ignored. In the next section, this reduced-form equation will be replaced by a structural labour supply equation which does explicitly model the relationship between participation and the preferred number of working hours on the one hand and after-tax wage rates and other income variables on the other.

The participation equation in this section is given by (2):

$$E_t^* = \beta_1 X_{t1} + \beta_2 X_{t2} + \ldots + \beta_m X_{tm} + \varepsilon_{2t}, \tag{2}$$

where E_t^* is a latent variable with the property that the individual participates

1 $P1$ is the probability that someone is employed at a wage below the minimum, given the fact that $W_t^* < M_t$ and that he or she wants to work.

on the labour market if $E_t^* \geq 0$, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, and ε_{2t} is an error term.

We assume that $(\varepsilon_{1t}, \varepsilon_{2t})$ is normally distributed with mean (0,0) and covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_\varepsilon^2 & \varrho\sigma_\varepsilon \\ \cdot & 1 \end{pmatrix}.$$

According to this model each individual can be in one of the following five 'states':

state 1*:* non-participant ($E_t^* < 0$).
state 2*:* participant, unemployed ($E_t^* > 0$, $W_t^* < M_t$, $I_t = 3$).
state 3*:* participant, employed, $W_t > M_t$ ($E_t^* > 0$, $W_t^* > M_t$).
state 4*:* participant, employed, $W_t < M_t$ ($E_t^* > 0$, $W_t^* < M_t$, $I_t = 1$).
state 5*:* participant, employed, $W_t^* = M_t$ ($E_t^* > 0$, $W_t^* < M_t$, $I_t = 2$).

If all wage rates were observed without measurement errors, it would still be impossible to observe whether an unemployed individual in the sample is in state 1 or in state 2, since no wage rate is observed for a non-worker and it is not observed whether someone who does not work would still be without work if there were no minimum wage regulation. It would however be possible to split up sample observations in four categories: those in states 1 and 2, those in state 3, those in state 4, and people in state 5. In the data set Meyer and Wise (1983a,b) used, most wage rates are either exactly known without measurement error (a correction for rounding errors is made by using a minimum wage interval instead of one minimum wage) or not known at all. Our data set contains only wage rates that are not exactly measured. We make use of a cross-section of Dutch households and before-tax wage rates are constructed from hours worked and after-tax labour income. Therefore, at least three possible sources of measurement errors are present:
- errors in after-tax labour income
- errors in hours worked
- errors in the transformation of the after-tax wage into the before-tax wage.

The explicit incorporation of a measurement error in the wage equation thus seems inevitable. On the other hand, we assume that there is no error in observing whether an individual is employed or not.

The measurement error is added to the wage equation additively. Let W_t^0 be the observed before-tax wage rate. We assume

$$log\ W_t^0 = log\ W_t + \delta_t \tag{3}$$

where $\delta_t \sim N(0, \sigma_\delta^2)$ and δ_t is independent of other random variables in the model.

Wages of a significant proportion of workers are missing. We assume that the (conditional) probability that a worker's wage is observed is the same for all individuals and denote this probability by R.

The presence of measurement errors and missing wage observations implies that the sample can only be split up in three subsamples: unemployed individuals, employed individuals without reported wage rate, and workers whose wage rate is observed (although with measurement error). For instance, if someone actually earns the minimum, *i.e.* is in state 5, a positive measurement error implies that his observed wage rate is above the minimum. Thus, states 3, 4, and 5 can no longer be distinguished with certainty. Still, if for example the observed wage rate is much higher than the minimum, then the probability that the individual is in state 3 is very large. This kind of information is incorporated in the likelihood function. The likelihood contribution of individuals in the three subsamples is easily derived by referring to the five states introduced above:

a. *unemployed individuals* are either in state 1 or state 2. The likelihood contribution is given by
$\Pr(E_t^* < 0) + \Pr(E_t^* > 0 \text{ and } W_t^* < M_t)(1 - P1 - P2)$.

b. *employed people without reported wage* are either in state 3, state 4, or state 5. The likelihood contribution is
$\{\Pr(E_t^* > 0 \text{ and } W_t^* > M_t) + \Pr(E_t^* > 0 \text{ and } W_t^* < M_t)(P1 + P2)\}\{1 - R\}$.

c. *employed persons with observed wage rate* can also be in either one of the states 3, 4 and 5; due to the measurement error, states 3, 4 and 5 cannot be distinguished. The likelihood contribution is given by

$$\{\Pr(E_t^* > 0 \text{ and } W_t^* > M_t \mid \varepsilon_{1t} + \delta_t = \log W_t^0 - \mathbf{X}_t'\alpha) f_1(\log W_t^0 - \mathbf{X}_t'\alpha) + \Pr(E_t^* > 0 \quad \text{and} \quad W_t^* < M_t \mid \varepsilon_{1t} + \delta_t = \log W_t^0 - \mathbf{X}_t'\alpha) f_1(\log W_t^0 - \mathbf{X}_t'\alpha) P1 + \Pr(E_t^* > 0 \text{ and } W_t^* < M_t) f_2(\log W_t^0 - \log M_t) P2\} R. \quad (4)$$

Here f_1 is the (normal) probability density function of $\varepsilon_{1t} + \delta_t$ and f_2 is the density function of δ_t. The conditional probabilities in (4) are bivariate normal; corresponding means and variances can easily be derived (see, *e.g.*, Johnson and Kotz, 1972).

2.1 *Data and Estimation Results*

The model introduced above has been estimated with data from the first wave of the 'Socio Economic Panel,' collected by the Dutch Central Bureau of Statistics (CBS) in April 1984. Our data set contains information on 3914 Dutch males and 4059 females of at least sixteen years of age. The following explanatory variables are included in the vector $\mathbf{X}_t$:

CON: a constant term.

DED2, DED3, DED4 and *DED5:* dummy variables referring to the individual's education level. At the lowest level, all dummies equal 0; at the second level $DED2 = 1$ and $DED3 = DED4 = DED5 = 0$, *etc.*

LAGE: the natural logarithm of the individual's age in April 1984.

L2AGE: the square of *LAGE.*

D65: dummy variable; $D65 = 1$ if the individual is older than 64 and 0 otherwise.

NCH: the number of children in the household ($NCH = 0$ if the individual is not one of the parents).

DCH6: dummy variable; $DCH6 = 1$ if the individual has children younger than six, $DCH6 = 0$ otherwise.

DHP: dummy variable; $DHP = 1$ if the individual is the family head or partner of the family head; $DHP = 0$ otherwise.

DSI: dummy variable; $DSI = 1$ in case of a one-person household; $DSI = 0$ otherwise.

D1P: dummy variable; $D1P = 1$ if the individual is the only parent in the household; $D1P = 0$ otherwise.

UNP: the unemployment percentage in the region where the individual is living.

Table 1 contains some sample statistics of these variables and of the endogenous variables and some information on the sample composition.

The model was estimated by maximum likelihood, using the algorithm introduced by Berndt *et al.* (1974). The parameter ϱ has been set equal to 0.[2] A Lagrange-multiplier test was performed to test the hypothesis $\varrho = 0$. This hypothesis was accepted at a 5% level for both males and females (the realisations of the asymptotically $\chi^2_{(1)}$-distributed test statistic were 0.4 and 2.6 for males and females respectively with a critical value of 2.7).

Estimation results are presented in Table 2. A * indicates significance on a 5% level. The upper panel of this table contains parameter estimates for the wage equation (1). The education level has the expected significant positive impact on productivity and thus on wage rates, for both males and females. Productivity increases with age for young people and decreases with age for older people. For females, the maximum is reached earlier (at age 37) than for males (at age 53) and the differences are smaller. Fig. 1 illustrates the total impact of age on the expected before-tax wage rate W^* (in absence of minimum wage regulations). Other individual characteristics are set equal to their sample means. The actual minimum wage rate in The Netherlands is also sketched as a function of age. The graph shows that the age-effect is larger for males than for females. Moreover, Fig. 1 reveals a remarkable difference in expected wage

2 If ϱ equals 0, parameters in the wage equation can be consistently estimated without use of the participation equation, but this estimation procedure is much less efficient.

TABLE 1a - SAMPLE STATISTICS

Variable	males mean	stand. dev.	min	max	numb. obs.	females mean	stand. dev.	min	max	numb. obs.
DED2	0.229	0.420	0	1	3914	0.291	0.454	0	1	4059
DED3	0.384	0.486	0	1	3914	0.282	0.450	0	1	4059
DED4	0.102	0.303	0	1	3914	0.081	0.273	0	1	4059
DED5	0.048	0.213	0	1	3914	0.010	0.100	0	1	4059
LAGE	3.628	0.430	2.77	4.54	3914	3.650	0.439	2.77	4.54	4059
L2AGE	13.347	3.103	7.69	20.64	3914	13.513	3.181	7.69	20.64	4059
D65	0.124	0.330	0	1	3914	0.140	0.347	0	1	4059
NCH	0.667	1.007	0	7	3914	0.696	1.020	0	7	4059
DCH6	0.153	0.360	0	1	3914	0.155	0.362	0	1	4059
DHP	0.722	0.448	0	1	3914	0.700	0.458	0	1	4059
DSI	0.081	0.273	0	1	3914	0.122	0.327	0	1	4059
DIP	0.007	0.081	0	1	3914	0.047	0.211	0	1	4059
UNP	17.615	2.537	14.6	24.2	3914	17.600	2.539	14.6	24.2	4059
Wbt	23.34	14.35	3.6	149.0	2089	16.01	7.90	3.7	81.8	1103
Wat	13.07	5.70	2.9	57.9	2089	10.40	4.24	2.8	38.9	1103
M	10.73	1.94	4.0	11.5	3914	10.78	1.88	4.0	11.5	4059
H	43.04	11.44	2.0	90.0	2396	26.96	14.41	2.0	90.0	1284

Explanation:
Wbt: before-tax hourly wage rate.
Wat: after-tax hourly wage rate.
M: before-tax minimum hourly wage rate.
H: actual number of working hours per week (zero-observations excluded).

TABLE 1b - SAMPLE COMPOSITION

	males	females
unemployed	1482	2750
employed, wage rate not observed	343	206
employed, wage rate observed	2089	1103

rates between males and females. This difference is largely a consequence of the fact that the mean education level is much higher for males than for females.

The significantly negative relationship between the wage rate and the regional unemployment percentage UNP suggests that productivity is lower in regions with high unemployment. It could, however, also mean that frictions on the labour market imply a gap between productivity and wage rate which is larger if unemployment is larger. The model does not take these kinds of effects into account.

TABLE 2 - ESTIMATION RESULTS (t-VALUES IN PARENTHESES)

Parameter	Females	Males
W^* equation		
CON	−15.13 (−8.3)*	−7.67 (−5.1)*
DED2	0.135 (3.3)*	0.169 (4.7)*
DED3	0.343 (8.1)*	0.292 (9.2)*
DED4	0.512 (10.2)*	0.595 (16.0)*
DED5	0.856 (11.4)*	0.784 (18.4)*
LAGE	9.870 (9.4)*	5.424 (6.5)*
L2AGE	−1.365 (−9.2)*	−0.684 (−5.9)*
D65	−0.0435 (−0.2)	−1.142 (−6.2)*
NCH	−0.064 (−3.7)*	−0.016 (−1.3)
CDH6	−0.052 (−1.1)	0.040 (1.3)
DHP	0.052 (1.0)	0.136 (3.3)*
DSI	0.108 (1.5)	0.059 (1.2)
DIP	0.114 (1.4)	0.002 (0.0)
UNP	−0.012 (−2.1)*	−0.021 (−5.5)*
P1	0.242 (3.5)*	0.163 (4.9)*
P2	0.400 (4.5)*	0 (−)
σ_ε (W^* equation)	0.370 (33.4)*	0.411 (63.1)*
σ_δ (meas. error)	0.103 (6.6)*	0.080 (4.5)*
E^* equation		
CON	−46.57 (−11.6)*	−73.50 (−14.4)*
DED2	0.272 (3.7)*	0.334 (2.8)*
DED3	0.428 (5.2)*	0.512 (4.5)*
DED4	0.627 (5.5)*	0.271 (1.8)
DED5	0.862 (3.9)*	0.493 (2.4)*
LAGE	27.89 (11.9)*	42.84 (14.5)*
L2AGE	−4.05 (−12.3)*	−6.07 (−14.6)*
D65	−0.104 (−0.5)	0.395 (1.2)
NCH	−0.283 (−8.3)*	0.154 (1.8)
DCH6	−0.850 (−9.9)*	−0.158 (−0.6)
DHP	−0.341 (−2.6)*	0.111 (0.6)
DSI	−0.228 (−1.5)	−0.608 (−3.3)*
DIP	−0.535 (−3.0)*	0.276 (0.5)
UNP	−0.0409 (−3.9)*	−0.027 (−1.6)

The estimates for *P1* and *P2* for females imply that, of the females who want to work but whose productivity is too low in relation to the minimum wage rate, 64% will be employed; 24% receive a wage below the minimum and 40% receive the minimum wage. The remaining 36% are involuntarily unemployed. For males, the estimates of *P1* and *P2* are much smaller, in particular the estimated probability of receiving the minimum wage equals zero. An explana-

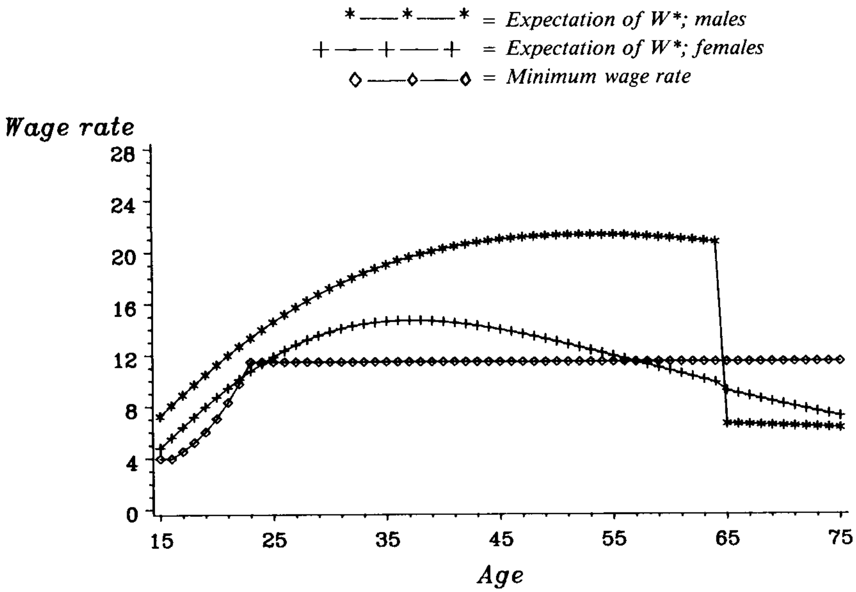

Figure 1 – Expectation of W^* and minimum wage rate as a function of age

tion for the large difference between males and females in this respect may be the fact that in typically female jobs (non-manufacturing sectors) productivity is more difficult to measure and easier to adapt. (In our sample, only 17% of those working in the manufacturing sector are females, whereas 49% of employees in the service sector are female.)[3]

Although the stimated variance σ_δ^2 of the measurement error is much smaller than the estimated variance of unobserved productivity differences σ_ε^2, it is significantly different from 0. This stresses the importance of including the measurement error in the model. According to the estimates, the measurement error explains 6% and 3% of the variation in wage rates of females and males respectively.

In Figs. 3 and 4 observed and simulated distributions of wage rates are compared. The differences $log\ W_t$ - $log\ M_t$ are divided into classes of width 0.05 each. Figs. 3 and 4 contain, for males and females respectively, observed frequencies, simulated frequencies without measurement errors, and simulated frequencies with measurement errors included. The simulations refer to

3 A variant of the model in which $P2$ depends on the gap between the threshold level and the marginal productivity ($log\ M_t - log\ W_t^*$), as in Meyer and Wise (1983b), was also estimated but the results were not satisfactory: The estimated impact was insignificant and had the counterintuitive sign.

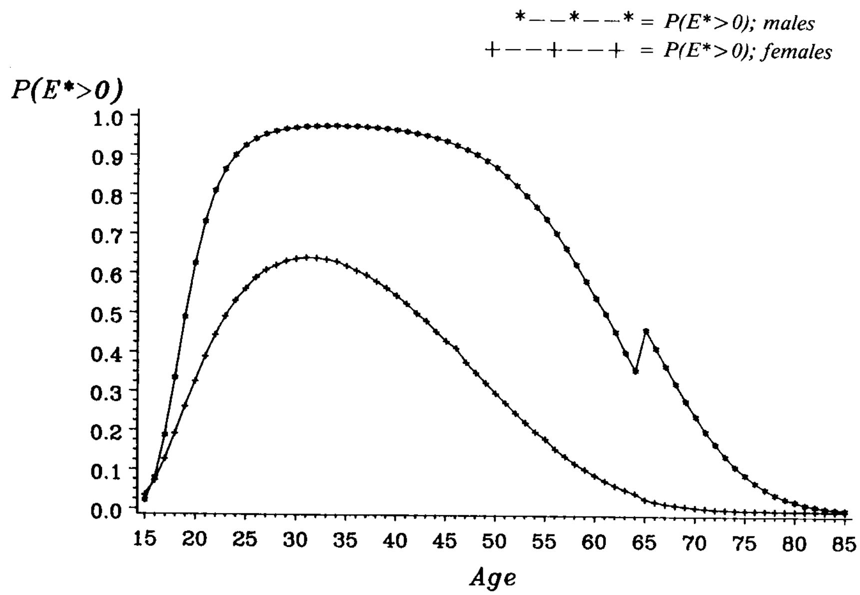

Figure 2 – Participation probability $P(E^*>0)$ as a function of age

employed people only, *i.e.* predicted wage rates have been weighted with the probabilities of not ending up in states 1 or 2. Comparison of observed frequencies with simulated frequencies reveals an important shortcoming of the model: the model cannot explain the relatively large density of wage observations in regions slightly *above* the minimum. The reason for this may be the fact that the minimum wage may push up wage rates to a level above the minimum, because of union agreements or other regulations, such as fixed periodic salary raises, or because of the rise of reservation wage rates of individuals looking for a (new) job.[4] Extension of the model in this direction is a topic of our future research.

2.2 *Some Simulations*

Using the estimation results it is possible to compute the probabilities of the five different states introduced in Section 2.1 for each individual.[5] Table 3

4 Another possible cause might be the fact that in January 1984 minimum wage rates in The Netherlands were lowered by 3%.

5 It may seem surprising that with these simulations all states can be distinguished, whereas observed behaviour does not admit this distinction. This hinges on model assumptions; actually, the shape of the observed wage distribution and the correlation of individual characteristics with observed wage rates on the one hand and unemployment or non-participation on the other hand together identify the distinction between states 1 and 2.

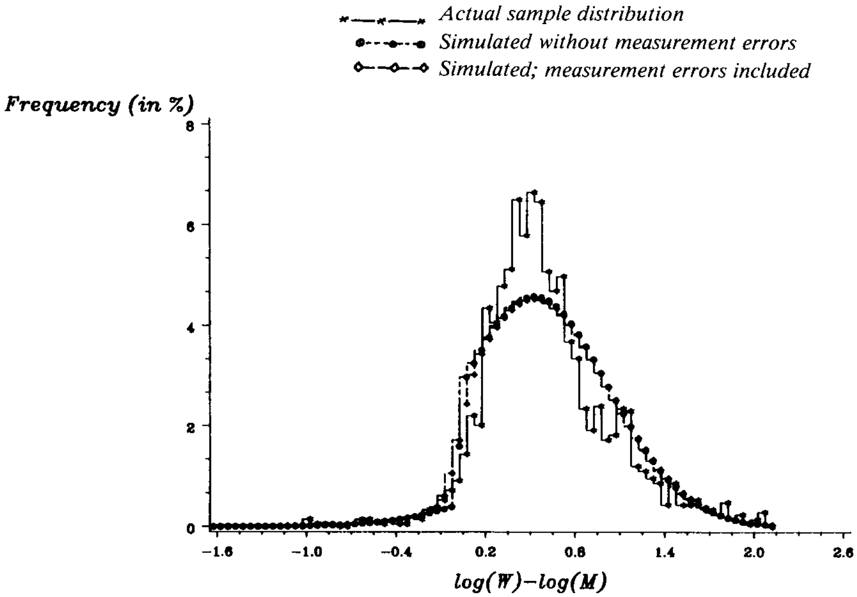

Figure 3 – Distribution of before-tax wage rates; males

contains the aggregate results, *i.e.* mean probabilities for different education levels and age groups. According to these results, 12.8% of all males older than 15 and 3.8% of all females are unemployed because their productivity is too low in relation to the minimum wage rate. The conditional probability that a man of lowest education level is employed, given that he participates on the labour market, is 75%. For males of medium education level ($DED3 = 1$), this probability is 88%. For females the corresponding probabilities are 82% and 93% respectively. The main reason for the difference between males and females is the difference in estimates for the probabilities *P1* and *P2*. The results imply that (state 2) unemployment as a fraction of the number of people who participate on the labour market is 13.7% for males and 10.5% for females. These figures are smaller than the macro-economic rates of registered unemployment in The Netherlands in April 1984, which are 16.4% and 19.0% respectively. This may be explained by the fact that the model does not explicitly take into account rigidities in the labour market other than minimum wage rate regulations.

Table 4 visualises the impact of a reduction of all minimum wage rates on the probability of state 2. It shows that, according to this model, involuntary unemployment would strongly fall if minimum wage rates are reduced by 10%. If all minimum wage rates are reduced by 10%, unemployment due to minimum wage regulations would fall by 28% for both males and females. Formulated in terms of employment, this result implies that the aggregate elasticity

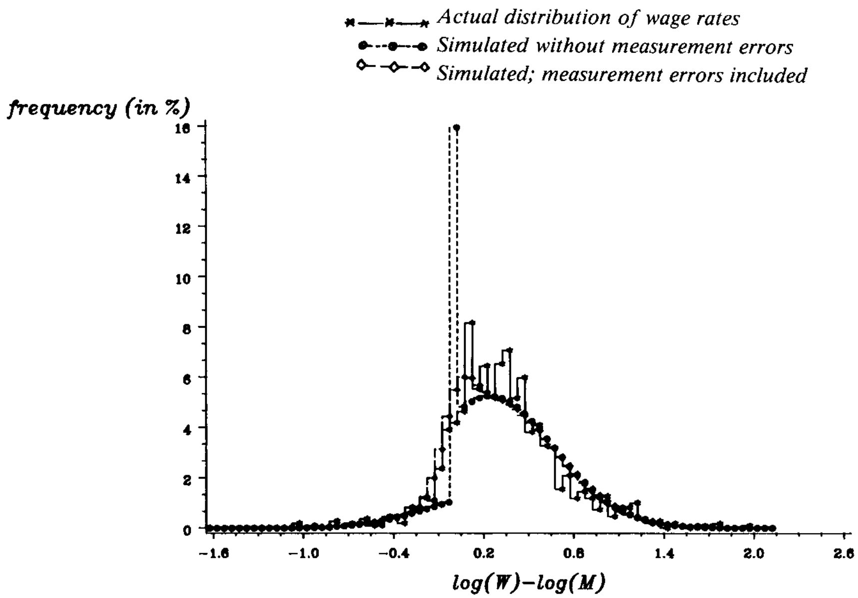

Figure 4 – Distribution of before-tax wage rates; females

of labour demand with respect to minimum labour costs is approximately -0.4 for males and -0.3 for females. This effect is rather strong compared to earlier findings in the US: Brown *et al.* (1982) give an overview and conclude that US studies suggest elasticities ranging from 0 to -0.3. The *ceteris paribus* condition that the W_t^* relation does not shift if the composition of the labour force changes may possibly explain why we find such a strong effect.

These results should be interpreted with caution for several other reasons as well: The suggested reduction of *all* minimum wages is not very realistic; if minimum wages are reduced, this probably applies to those with a new job only. The instantaneous effects thus would be much smaller than the numbers in Table 4 suggest. Secondly, it has become clear from Figs. 3 and 4 in the previous section and from the figures in Table 3 discussed above, that the model does not yield a complete description of rigidities in the labour market. Finally, note that the model describes the labour market partially and does not take macro-economic effects into account. If the reduction of before-tax wage rates is followed by a reduction in after-tax incomes and leads to a fall in domestic expenditures, a negative effect on employment may result.

3 A STRUCTURAL LABOUR SUPPLY EQUATION

In order to be able to analyse the effects of changes in the tax regime or minimum wage and unemployment compensation regulations, it is necessary to

TABLE 3 - PROBABILITIES (IN %) ON STATES IN THE LABOUR MARKET

	state 1	state 2	state 3	state 4	state 5	sample number
males						
age below 25	50.7	12.5	34.3	2.4	0.0	722
25–34	4.5	13.8	79.0	2.7	0.0	924
35–44	2.6	7.2	88.8	1.4	0.0	767
45–54	13.5	5.9	79.4	1.2	0.0	553
55–64	46.3	3.4	49.6	0.7	0.0	463
65 and older	82.8	12.8	2.0	2.5	0.0	485
education level						
1	51.4	12.1	34.1	2.3	0.0	928
2	31.0	12.4	54.2	2.4	0.0	895
3	17.4	9.9	70.8	1.9	0.0	1504
4	17.9	2.6	79.0	0.5	0.0	401
5	15.5	1.2	83.1	0.2	0.0	186
all males	28.6	9.8	59.7	1.9	0.0	3914
females						
age below 25	51.8	5.1	34.1	3.4	5.6	725
25–34	51.2	4.8	35.5	3.2	5.3	939
35–44	53.2	4.3	34.9	2.9	4.7	725
45–54	62.5	4.2	25.8	2.8	4.7	582
55–64	84.1	2.7	8.4	1.8	3.0	519
65 and older	98.0	0.5	0.7	0.3	0.5	569
education level						
1	81.5	3.4	9.0	2.3	3.8	1362
2	62.0	5.1	23.9	3.4	5.6	1182
3	52.0	3.5	38.1	2.4	4.0	1144
4	44.9	2.1	49.4	1.4	2.3	330
5	32.8	0.2	66.5	0.2	0.3	41
all females	64.1	3.8	25.4	2.5	4.2	4059

work with a more structural model of the labour market than the one introduced in Section 2. In this section a first step towards such a model is made: The reduced-form equation for labour market participation is replaced by a structural labour supply equation that explains the relationship between labour supply on the one hand and on the other hand the after-tax wage rate, household income apart from the individual's wage, possible unemployment benefits and several of the individual characteristics already considered in Section 2.

Since the purpose of this paper is not in the first place the estimation of a complete labour supply model, the specification of the labour supply equation is kept rather simple. We use a simplified (1-person) version of the model in-

TABLE 4 - IMPACT OF A REDUCTION OF ALL MINIMUM WAGE RATES ON THE PROBABILITY OF STATE 2 UNEMPLOYMENT

1 group	2 sample number	3 probability of state 2	4 prob. after 10% reduction	5 difference (in %)
males per education level				
education				
1	928	12.1	9.3	−23.3
2	895	12.4	9.1	−26.7
3	1504	9.9	7.0	−28.8
4	401	2.6	1.7	−33.9
5	186	1.2	0.9	−30.1
males per age group				
age				
below 25	722	12.5	9.3	−25.5
25-34	924	13.8	9.7	−30.1
35-44	767	7.2	4.6	−35.8
45-54	553	5.9	3.8	−36.3
55-64	463	3.4	2.2	−37.0
65 and older	485	12.8	12.1	−5.5
all males	3914	9.8	7.2	−27.6
females per education level				
education				
1	1362	3.4	2.7	−20.8
2	1182	5.1	3.7	−26.3
3	1144	3.5	2.4	−33.5
4	330	2.1	1.3	−39.5
5	41	0.2	0.1	−52.2
females per age group				
age				
below 25	725	5.1	3.6	−28.1
25-34	939	4.8	3.5	−28.0
25-44	725	4.2	3.0	−29.1
45-54	582	4.2	3.1	−26.9
55-64	519	2.7	2.1	−20.8
65 and older	569	0.5	0.4	−13.6
all females	4059	3.8	2.8	−27.8

Explanation
column 3: probability of state 2 (involuntary unemployment) before the minimum wage reduction
column 4: the same probability after a reduction of all minimum wage rates with 10%
column 5: the difference between columns 4 and 3 as a percentage of column 3

troduced by Hausman and Ruud (1984), which yields an individual labour supply function that is linear in other income and quadratic in the after-tax wage rate:

$$H^* = h(w, Y) = \pi_0 + \pi_1 w + \pi_2 w^2 + \beta Y + \textstyle\sum_{j=1}^{K} \psi_j (1 + \beta w) Z_j, \tag{4}$$

where H^* is optimal labour supply taking into account the linear budget constraint $C = wH + Y$ (where C is the sum of consumption and savings)[6] only, Y is other household income, $\mathbf{Z} = (Z_1, \ldots, Z_K)'$ is a vector of individual characteristics, and the Greek letters are unknown parameters.[7]

The more complicated household version of this model has been estimated with other Dutch data by Kapteyn *et al.* (1988) and by Kapteyn and Woittiez (1988). Kapteyn *et al.* (1988) also derive the corresponding direct utility function $U(H, C)$ and discuss the problem of regularity of the demand system (*i.e.*, in particular, concavity of the cost function).

The nature of the data on preferred hours that we use (the scenario will be explained in the next subsection) implies that there is no need to take into account the progressive character of the tax system but we do want to incorporate unemployment benefits. Therefore, an individual's budget set consists of two linear segments, as shown in Fig. 5 below. In this figure, *OHI* denotes other household income not including unemployment benefits and *UC* is the (maximal) unemployment compensation (for given *OHI*). It is assumed that if an unemployed individual starts working, the unemployment compensation is (as long as it is non-negative) reduced by 75% of the earned after-tax wage.[8] This implies that the marginal wage rate on the segment *AB* in the figure equals 0.25 w, where w is the after-tax wage rate in absence of unemployment benefits. If the individual works many hours a week (more than $H_0 = 4UC/(3w)$), unemployment benefits play no role and the marginal wage rate equals w. This is the segment *BD* in the picture.

Optimal labour supply can be on either one of the segments *AB* and *BD*. Because the budget set is non-convex, two different local utility maxima are possible. In that case, values of the (direct or indirect) utility function must be compared.

6 In a life-cycle framework, it would be more appropriate to exclude savings from C and thus also use total expenditures instead of income. However, this was not possible since data on total expenditures or savings were not available.

7 This is a reparameterisation of the original Hausman-Ruud equation, given by

$$H^* = \beta\{\vartheta + Y + \delta w + 0.5\gamma w^2\} + \gamma w + \delta,$$

namely

$$\delta_0 + \sum_{j=1}^{K} \psi_j Z_j = \delta,\ \pi_0 = \delta_0 + \beta\vartheta,\ \pi_1 = \beta\delta + \gamma,\ \pi_2 = 0.5\beta\gamma.$$

This labour supply equation is derived (with Roy's identity) from the indirect utility function

$$V(w, M) = e^{\beta w}\{\vartheta + M + \delta w + 0.5\gamma w^2\}.$$

8 This is a good approximation for the most common system of social security in The Netherlands.

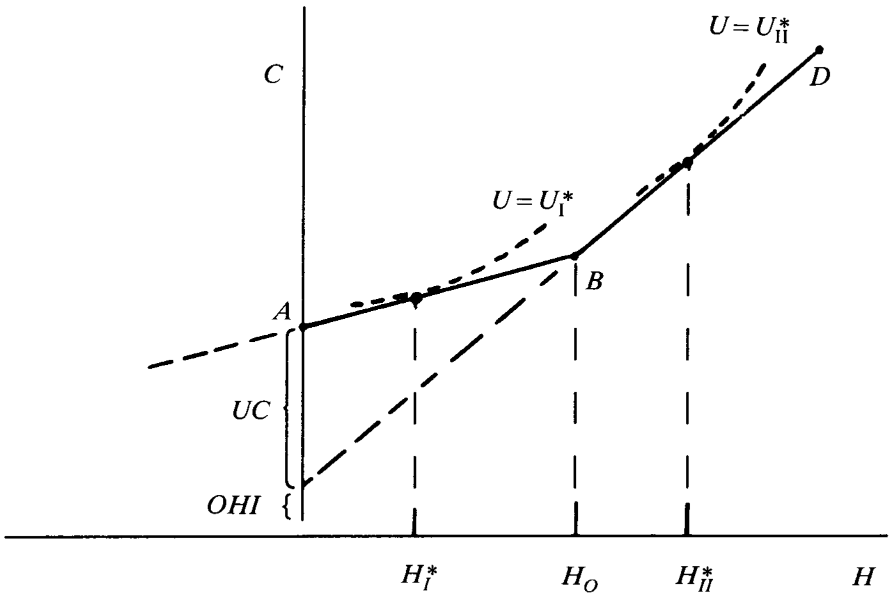

Figure 5 – The budget set and the utility maximum

The stochastic specification of flexible labour supply models in case of non-convex budget sets is a delicate matter (see *e.g.* Kooreman and Kapteyn, 1986). In this paper we do not allow for random preferences, but only for optimisation errors. These errors enter in two different ways: In the chosen number of hours, given the choice between the two segments (*i.e.* for given regime), and secondly in the choice of the regime. The two error sources are represented by random variables ζ and η, respectively.

Let

$$H_i^* = h(w_i, y_i) \text{ and } U_i^* = U(H_i^*, w_i H_i^* + y_i) \; (i = I, II),$$

where $w_I = 0.25w$, $y_I = UC + OHI$ (corresponding to the first segment), and $w_{II} = w$, $y_{II} = OHI$ (corresponding to the second segment).
In absence of optimisation errors, Regime I is chosen if $U_I^* > U_{II}^*$ and Regime II if $U_I^* < U_{II}^*$. The optimisation error η is incorporated as follows:
If $U_I^* - U_{II}^* + \eta > 0$, Regime I is chosen;
if $U_I^* - U_{II}^* + \eta < 0$, Regime II is chosen.
Let $P_I = \Pr(U_I^* - U_{II}^* + \eta > 0)$ and $P_{II} = 1 - P_I$.
The preferred number of hours, errors included, is now given by

$$H^P = \begin{cases} H_I^* + \zeta \text{ with probability } P_I \\ H_{II}^* + \zeta \text{ with probability } P_{II} \end{cases} \qquad (5).$$

Note that H^P can be negative, implying that the individual prefers not to work. It is assumed that the error terms ζ and η are independent and normally distributed with mean 0 and variances σ_ζ^2 and σ_η^2 respectively.

From (5), it is straightforward to derive the likelihood contribution for the (one-equation) labour supply model for employed as well as unemployed individuals if the after-tax wage rate is known. Since the wage rate is unknown for all unemployed and some employed individuals, simultaneous estimation of wage equation (1) and labour supply would be the most appropriate way to estimate the complete model. Because of the complexity of the labour supply model – mainly due to the non-convex budget sets – this is computationally intractable. Therefore, as is usual practice in empirical work on pure labour supply models, we use predictions to replace unknown wage rates. These predictions are based on the model and the estimation results discussed in Section 2.

3.1 *Data and Estimation*

The labour supply equation has been estimated with data from the same cross-section as used for the model in Section 2. Some observations of the 3914 males and 4059 females were removed because a component of household non-labour income was missing. Eventually, data on 3794 males and 3941 females were used.

In most labour supply studies, actual working hours is the endogenous variable. Particularly in The Netherlands, however, actual hours are not only determined by individual preferences, but also to a large extent by demand-side and institutional restrictions. There are two ways to deal with this problem. The first option is to include the restrictions explicitly in the model and start from the assumption that actual hours reflect utility optimising behaviour, but with a smaller choice set than the budget set depicted in Fig. 5. This approach is for instance followed by Tummers and Woittiez (1988) and Van Soest *et al.* (1988). The other approach is to consider preferred hours as the endogenous variable. An extensive motivation for this is given in Kapteyn *et al.* (1988). The main reason is the fact that preferred hours directly reflect individual utility maximising behaviour over the whole budget set. The latter approach is followed in this paper.

Preferred hours in the data set are for the employed individuals the answer to the question

> 'How many hours a week would you like to work if you could choose freely and if your hourly after-tax wage rate remains as it is now? Assume that other family members do not change their number of working hours.'

The formulation of this question motivates the use of a linear budget set, *i.e.* there is no need to incorporate the progressive character of the tax system, since

TABLE 5a – SAMPLE COMPOSITION

category	males	females
employed, preferred hours known	2360	1255
employed, preferred hours not known	11	16
looking for a job, preferred hours known, not receiving unemployment compensation	40	176
looking for a job, preferred hours known, receiving unemployment compensation	248	89
looking for a job, preferred hours not known, not receiving unemployment compensation	1	1
looking for a job, preferred hours not known, receiving unemployment compensation	8	0
unemployed, not looking for a job, not receiving unemployment compensation	736	2163
unemployed, not looking for a job, receiving unemployment compensation	391	241

TABLE 5b – SAMPLE STATISTICS

variable	males					females				
	mean	stand. dev.	min	max	numb. observ.	mean	stand. dev.	min	max	numb. observ.
H^P	39.71	10.08	1	90	2648	25.42	12.53	1	75	1520
OHI	383.57	420.65	0	4011	3794	636.21	410.22	0	4011	3941
UC	316.16	155.95	3	1108	646	212.30	122.59	1	699	330

Explanation:

H^P : preferred hours; zero observations excluded

OHI: family income, the individual's wage and unemployment compensation excluded (Dfl per week)

UC : unemployment compensation (Dfl per week); zero observations excluded

the scenario implied by the question states that the after-tax and not the before-tax wage rate remains the same. Some employed individuals do not answer this question; we assume their preferred number of hours is positive. Someone without a paid job is asked whether he or she is looking for work and if so for how many hours a week. Since it is not asked which wage rate the individual has in mind while answering this question, the use of predicted wage rates cannot be avoided.

Sample information about preferred labour supply and household income is summarized in Table 5. For other variables (wage rates and individual characteristics) we refer to Table 1. The model has been estimated for males and females separately by maximum likelihood using the algorithm of Berndt *et al.* (1974). Estimation results without imposition of concavity of the cost

TABLE 6a – ESTIMATION RESULTS WITHOUT IMPOSITION OF CONCAVITY (STANDARD ERRORS IN PARENTHESES)

parameter	males		females	
π_0 (constant term)	−765.1	(33.1)	−260.7	(40.6)
π_1 (wage rate)	8.43	(0.63)	6.90	(0.34)
π_2 (squared wage rate)	−0.048	(0.0028)	−0.168	(0.0091)
β (other income)	−0.0076	(0.0007)	−0.0034	(0.0007)
σ_ζ (hours equation)	18.11	(0.24)	19.21	(0.45)
σ_η (utility comparison)	82.2	(16.4)	83.7	(10.4)
ψ_1 (*LAGE*)	452.4	(19.1)	159.4	(23.7)
ψ_2 (*L2LAGE*)	−64.64	(2.68)	−24.81	(3.36)
ψ_3 (*D65*)	−12.51	(1.80)	−11.03	(2.12)
ψ_4 (*NCH*)	0.63	(0.47)	−2.45	(0.34)
ψ_5 (*DCH6*)	−2.91	(1.33)	−0.76	(0.91)
ψ_6 (*DHP*)	−5.18	(1.22)	−14.05	(1.38)
ψ_7 (*DSI*)	−11.01	(1.41)	−8.75	(1.70)
ψ_8 (*DIP*)	−6.05	(3.43)	−10.72	(1.86)

TABLE 6b – ESTIMATION RESULTS AFTER IMPOSITION OF CONCAVITY (STANDARD ERRORS IN PARENTHESES)

parameter	males		females	
π_0 (constant term)	−862.78	(--) [10]	−370.41	(--) [10]
π_1 (wage rate)	10.34	(0.78)	4.15	(0.36)
π_2 (squared wage rate)	−0.0164	(0.0009)	−0.037	(0.0021)
β (other income)	−0.0101	(0.0007)	−0.0032	(0.0007)
σ_ζ (hours equation)	18.53	(0.24)	22.11	(0.51)
σ_η (utility comparison)	61.45	(18.9)	37.97	(8.10)
ψ_1 (*LAGE*)	512.4	(20.8)	227.1	(27.5)
ψ_2 (*L2AGE*)	−73.06	(2.92)	−34.05	(3.89)
ψ_3 (*D65*)	−13.64	(1.93)	−19.67	(3.24)
ψ_4 (*NCH*)	0.63	(0.49)	−3.06	(0.37)
ψ_5 (*DCH6*)	−3.47	(1.44)	−8.24	(0.92)
ψ_6 (*DHP*)	−6.02	(1.33)	−14.07	(1.55)
ψ_7 (*DSI*)	−13.68	(1.52)	−8.28	(1.92)
ψ_8 (*DIP*)	−7.67	(3.43)	−12.07	(1.99)

function[9] are mentioned in Table 6a. The meaning of the individual characteristics *LAGE*, ..., *DIP* is explained in Section 2. These results imply that for 1.7% of all males and 1.9% of all females in the sample (in particular those with extremely high wage rates) concavity is not satisfied. For these in-

9 The cost function for this system can be obtained by inverting the indirect utility function given in Note 5:

$$C(w, U) = e^{-\beta w}U - \{\vartheta + \delta w + 0.5\gamma w^2\}$$

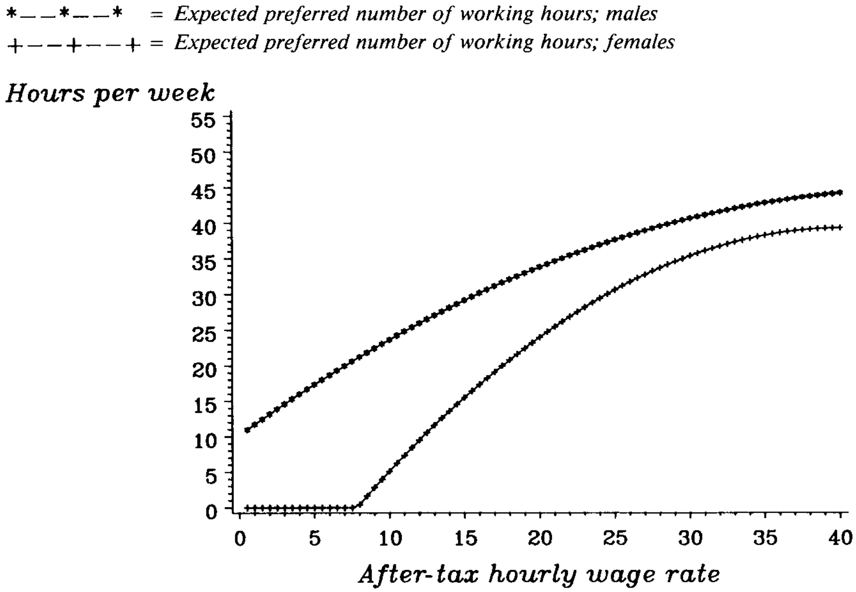

Figure 6 – Expected preferred number of working hours as a function of the wage rate

dividuals the micro-economic foundation (utility maximising behaviour) is lost.

The model has also been estimated with imposition of concavity for *all* males and females.[10] The estimation results in this case are mentioned in Table 6b. They are not essentially different from the results without imposition of concavity. A likelihood ratio test rejects the hypothesis that the concavity condition is satisfied for all sample observations, for males as well as females. Because we want to perform policy simulations for all individuals, including those with a high wage rate, our simulations are based on the estimation results in Table 6b. Therefore, in what follows we restrict ourselves to the discussion of the results with imposition of concavity.

All parameters except one (ψ_4 for males) are significantly different from 0 on a 5% level. The negative estimates of the β's imply that both male and female leisure are normal goods.

The dependence of preferred hours on the after-tax wage rate is shown in Fig. 6, where expected preferred hours are sketched as a function of the after-tax wage rate for the 'average' male and female with mean other household in

10 Imposition of concavity is achieved by imposing linear restrictions on the constant term π_0 in terms of other parameters (see Kapteyn *et al.* (1988) for details). One of these restrictions eventually appears to be binding; therefore in Table 6b no standard error for the estimate of the constant term was computed.

come and without unemployment compensation. Both male and female labour supply functions appear to be forward bending. The wage elasticities of the average preferred number of working hours are 0.38 for males and 1.88 for females. According to a recent overview in Theeuwes (1988), these numbers are rather high compared with earlier Dutch studies, which may be explained by the fact that we use desired and not actual hours. Theeuwes mentions mean elasticities of 0.07 for males and 1.39 for females.

In Fig. 7, expected preferred hours are sketched as a function of age. Other characteristics and wage rates are set equal to the sample means. The graph reveals the fact that females reach their 'labour supply top' at an earlier age than males. Only very few people older than 65 want to work. The downward jump in preferred hours at age 65 might have a sociological background: In The Netherlands, it is uncommon not to retire at the age of (at most) 65. (See Kapteyn and Woittiez (1988) who explicitly incorporate the reference group as an explanatory variable in the labour supply model.) Note that Fig. 7 refers to a partial effect only: the fact that the wage rate also varies with age (see the estimation results for the wage equation in Section 2) is not taken into account. The impact of variables relating to family composition on preferred hours is stronger for females than for males. Most of the estimates have the expected sign.

The participation probability in the labour supply model is defined as the probability that preferred hours H^P given by (5) (including both sources of op-

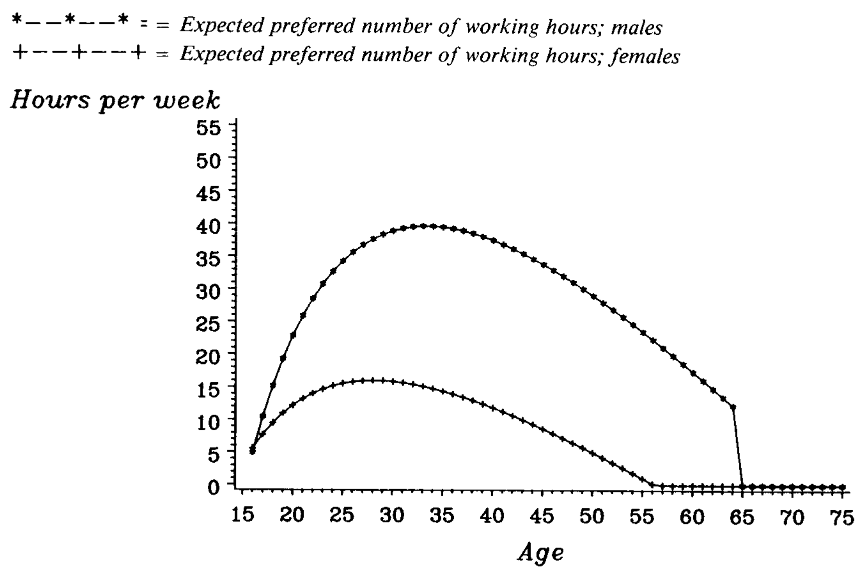

Figure 7 – Expected preferred number of working hours as a function of age (for a fixed after-tax wage rate)

timisation errors) are positive. The estimated participation probabilities for 'representative' individuals are sketched in Figs. 8 and 9 as functions of the wage rate and the level of unemployment benefits respectively. From Fig. 8 it is clear that the sensitivity of the participation decision with respect to one's own wage rate changes is much larger for females than for males. For the average female, the probability ranges from 0.16 for low wage rates to 0.95 for high wage rates, whereas 64% of the 'average' males even would like to work (few hours a week) without a wage.

The estimated impact of unemployment benefits on the participation probability is quite small, as is revealed in Fig. 9. An explanation might be the fact that people can work few hours without losing unemployment compensation.

4 SIMULATIONS BASED ON THE EXTENDED MODEL

In this section the results of some policy simulations based on the wage equation (1) in Section 2 and the labour supply equation (5) in Section 3 are presented. With the estimated wage equation the systematic part of the before-tax wage rate is generated for each individual in the sample. A drawing of the error term ε is added. This is repeated five times (with independent drawings of ε) for each observation. The before-tax wage rate is transformed into an after-tax wage rate and this wage rate is inserted into the labour supply equation. As a result, probabilities on the five labour market states as described in Section

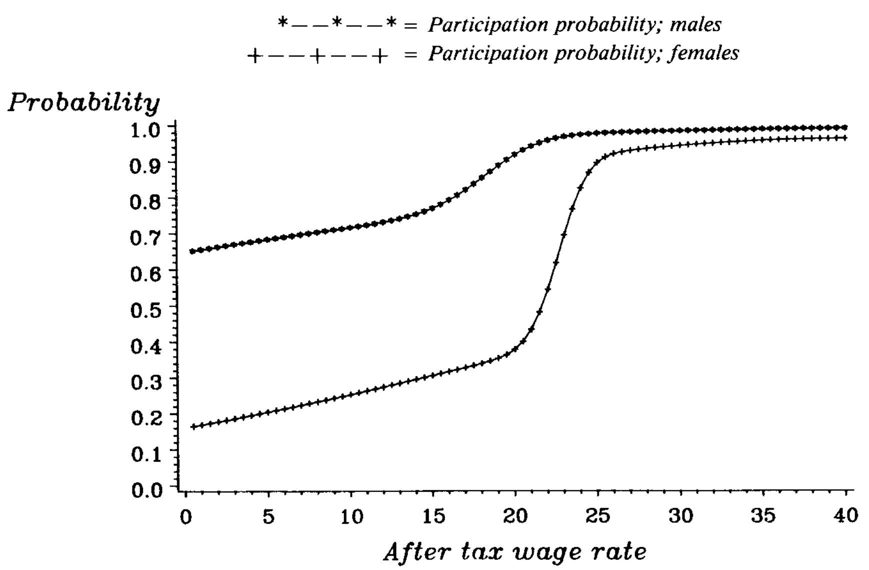

Figure 8 – Participation probability as a function of the after-tax wage rates (for the average level of unemployment benefits)

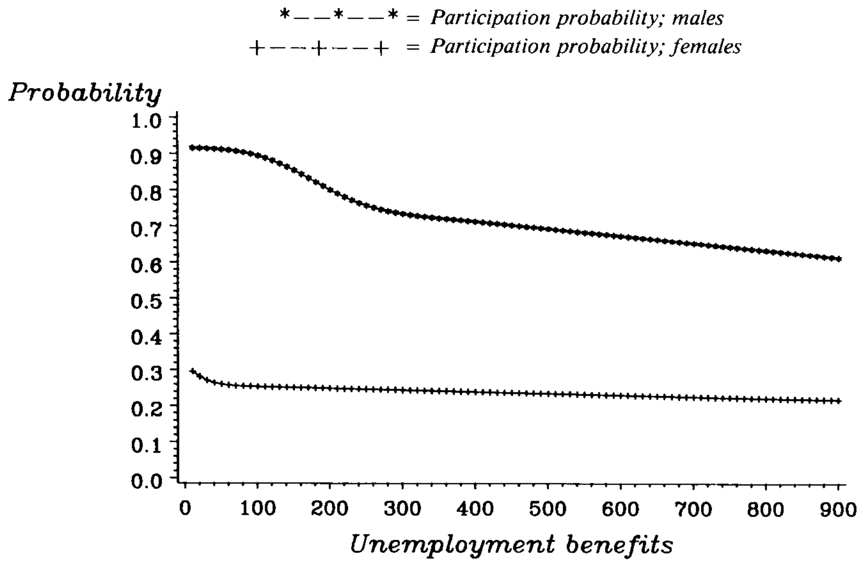

Figure 9 – Participation probability as a function of unemployment benefits (for the average after-tax wage rate)

2 are computed. The results are aggregated per education level and per age category. These operations are performed in three different situations: for the actual (1984) minimum wage regulations and the actual tax regime, after a change in the minimum wage regulations and after a change in the tax regime.

Table 7 presents simulation results before policy changes. There is a remarkable difference between the figures in the columns 3 through 6 of this table and the corresponding figures in Table 3 of Section 2. Note that figures in Table 3 are based upon estimation results that only take into account information about *actual* wage rates and *actual* participation, whereas Table 7 is also based on information about *preferred* labour supply. Apparently, the data on preferred labour supply (together with the model assumptions) imply a larger tendency to work than can be predicted by actual employment figures (and model assumptions). Comparison with sample information yields the following results.

	sample realisation	simulation with reduced form model (Table 3)	simulation with extended model (Table 7)
Males			
working	62.1%	61.6%	71.3%
looking for work	7.6%	9.8%	10.0%
non-participant	30.2%	28.6%	18.6%

	sample realisation	simulation with reduced form model (Table 3)	simulation with extended model (Table 7)
Females			
working	32.2%	32.1%	42.6%
looking for work	6.6%	3.8%	4.4%
non-participant	61.2%	64.1%	53.0%

The extended model predicts a tendency to work which is extremely large. This might be a consequence of a lack of flexibility in the specification of the labour supply model, since this equation has to explain participation decision and preferred hours at the same time. On the supply side of the labour market, unobserved fixed costs of working (for females in particular) may play a role. On the other hand, restrictions on the demand side that are not incorporated, such as a lack of job offers with few working hours, also might play a role.

Columns 7 through 10 in Table 7 refer to predicted wage rates. In columns 7 and 8 before-tax wage rates are presented; column 7 gives unweighted means of the predictions per age and education category, whereas the figures in column 8 are weighted means, where the weights are determined by the probability that someone is employed. Thus the wage rates in column 8 are larger than those in column 7 for two reasons: those with a relatively high wage rate have the largest probability of a large enough productivity to be employed and also have the largest participation probability, since labour supply is forward bending.

Columns 9 and 10 are similar to columns 7 and 8 respectively but refer to predicted after-tax wage rates. The last column of the table contains preferred hours, as prediced by the model of Section 3. Zeroes are fully included in the computation of the category means.

The first policy simulation we discuss is a reduction of all minimum wage rates in the sample by 10%. This same change was also considered in Section 2, where the simulation was performed with the reduced-form model. Table 8 shows the results in terms of deviations from the numbers in Table 7. Because very few people over 65 want to work anyhow, these people are not taken into account in the policy simulations in this section (they were in Section 2 and in Table 7). Results are very similar to the corresponding results in Section 2. Involuntary unemployment is strongly reduced because the productivity threshold is lowered. This effect is much stronger than the labour supply effect: The lowering of minimum wage rates leads to a smaller expected wage rate for low-productive persons and thus to a smaller propensity to work.[11] For females, the productivity effect of a 10% reduction of minimum wage rates is a decrease in involuntary unemployment of about 27%, whereas the supply effect only causes a 2% decrease. For males the supply effect is even smaller.

11 If the predicted value of W_t^* is smaller than M_t, the prediction of W_t is a weighted mean of W_t^* and M_t, where the weights are determined by the probabilities *P1* and *P2*.

TABLE 7 - SIMULATION OF THE ACTUAL (1984) SITUATION

1 group	2 number	3 probability	4	5	6	7 wage rates	8	9	10	11 hours
males										
education										
1	901	33.5	14.3	49.4	2.8	12.3	16.5	8.2	10.4	17.7
2	867	18.2	13.1	66.1	2.5	15.6	18.5	10.0	11.6	26.3
3	1459	12.9	8.8	76.6	1.7	19.7	22.3	12.3	13.6	32.1
4	390	10.5	1.9	87.3	0.4	28.8	30.8	17.1	18.2	37.0
5	177	10.7	0.6	88.6	0.1	34.7	37.2	20.2	21.4	38.9
age										
below 25	697	17.8	18.2	60.4	3.5	10.4	12.1	7.1	8.0	20.5
25-34	911	2.4	13.8	81.2	2.7	20.0	21.9	12.5	13.5	29.5
35-44	751	1.8	6.0	91.1	1.2	24.5	25.6	14.8	15.4	42.0
45-54	539	6.0	6.7	86.1	1.3	24.2	25.7	14.6	15.4	32.5
55-64	448	22.7	4.7	71.7	0.9	24.2	26.2	14.5	15.5	17.1
older than 64	448	92.5	5.6	0.8	1.1	6.8	9.7	5.2	6.9	0.0
all males	3794	18.6	10.0	69.4	1.9	18.7	21.6	12.1	13.6	28.2
females										
education										
1	1321	68.9	5.2	16.7	9.3	11.1	12.1	8.1	8.6	3.1
2	1149	50.6	5.4	34.3	9.7	12.8	14.0	9.1	9.6	7.7
3	1109	42.4	3.5	47.8	6.3	15.5	17.1	10.6	11.4	11.8
4	322	36.3	1.5	59.5	2.7	19.5	21.6	13.1	14.3	16.2
5	40	20.8	0.2	78.6	0.4	29.9	32.1	18.6	19.9	27.1
age										
below 25	705	28.1	6.6	53.6	11.7	10.4	11.2	7.5	8.0	15.3
25-34	928	40.8	5.3	44.4	9.5	15.7	17.8	10.7	11.9	11.9
35-44	706	44.2	4.3	43.8	7.7	16.3	18.7	11.1	12.4	9.6
45-54	562	52.6	4.4	35.1	7.9	15.2	17.8	10.4	11.8	5.9
55-64	500	74.5	4.3	13.6	7.6	12.8	15.0	9.1	10.3	0.9
older than 64	540	98.2	0.5	0.5	0.8	10.7	12.0	8.0	8.7	0.0
all females	3941	53.0	4.4	34.7	7.9	13.7	15.1	10.1	10.8	8.2

Explanation:

3: not participating on the labour market
4: (involuntarily) unemployed due to a lack of productivity
5: employed, wage rate above the minimum level
6: employed, wage rate on or below the minimum
7: predicted before-tax wage rates, unemployed people included
8: predicted before-tax wage rates, unemployed people excluded
9: predicted after-tax wage rates, unemployed people included
10: predicted after-tax wage rates, unemployed people excluded
11: preferred hours, non-participants included

TABLE 8 – SIMULATION OF A REDUCTION OF ALL MINIMUM WAGE RATES

1	2	3	4	5	6	7	8	9
group	sample number	state 2 unemployment actual	– 10% abs	– 10% rel	before-tax wage actual	– 10% rel	after-tax wage actual	– 10% rel
males								
education								
1	708	17.1	– 4.4	– 25.8	16.5	– 2.8	10.5	– 2.1
2	780	13.4	– 4.0	– 30.2	18.6	– 2.4	11.6	– 1.8
3	1336	9.1	– 3.0	– 32.7	22.3	– 1.8	13.6	– 1.4
4	361	2.0	– 1.1	– 53.8	30.3	– 0.7	17.9	– 0.6
5	177	0.8	– 0.7	– 87.2	37.8	– 0.5	21.7	– 0.4
age								
below 25	697	18.2	– 5.1	– 28.1	12.3	– 2.6	8.1	– 2.0
25–34	911	13.2	– 3.9	– 29.6	22.1	– 2.3	13.6	– 1.7
35–44	751	6.8	– 2.3	– 34.0	25.1	– 1.4	15.2	– 1.1
45–54	539	6.4	– 2.0	– 30.9	25.8	– 1.3	15.4	– 1.0
55–64	448	5.2	– 1.9	– 36.3	26.2	– 1.5	15.5	– 1.2
all males	3346	10.6	– 3.2	– 30.3	22.4	– 2.1	13.6	– 1.7
females								
education								
1	963	6.8	– 1.7	– 24.8	12.3	– 2.2	8.6	– 2.0
2	1062	5.9	– 1.7	– 29.5	14.1	– 1.6	9.7	– 1.4
3	1040	3.7	– 1.3	– 34.4	17.3	– 1.1	11.5	– 0.9
4	299	2.1	– 0.9	– 40.2	21.4	– 0.7	14.2	– 0.6
5	37	0.2	– 0.0	– 4.0	32.3	0.0	19.9	– 0.0
age								
below 25	705	6.8	– 2.0	– 28.6	11.0	– 1.5	7.9	– 1.4
25–34	928	5.3	– 1.6	– 30.8	18.0	– 1.4	12.0	– 1.2
35–44	706	4.3	– 1.4	– 32.0	19.0	– 1.2	12.5	– 1.1
45–54	562	4.4	– 1.4	– 30.9	17.7	– 1.4	11.8	– 1.3
55–64	500	4.2	– 0.9	– 20.5	15.1	– 2.1	10.3	– 1.9
all females	3401	5.1	– 1.5	– 29.2	16.1	– 1.5	10.9	– 1.3

Explanation:

columns 3 through 5 refer to the probability that someone's productivity is not large enough to work (state 2 unemployment)

3: this probability in the actual (1984) situation

4: absolute change in the column 3 probability after a reduction of all minimum wage rates with 10%

5: relative change in the column 3 probability after this 10% reduction; columns 6 and 7 refer to before-tax wage rates of employed persons

6: the actual (1984) situation

7: the relative change after a 10% reduction of minimum wage rates; columns 8 and 9 refer to after-tax wage rates of employed people

8: see 6

9: see 7

TABLE 9 - SIMULATION OF A REDUCTION OF INCOME TAXES WITH 10%

1	2		3		4		5		6	7	8	
group	abs	rel	abs	rel	abs	rel	abs	rel	rel	rel	abs	rel
males												
education level												
1	−0.9	−5.0	−4.3	−25.4	6.0	9.7	−0.8	−25.4	−2.8	7.7	1.0	4.5
2	−0.7	−7.3	−4.0	−29.8	5.5	7.4	−0.8	−29.8	−2.4	8.0	1.2	4.0
3	−0.6	−10.1	−3.0	−32.4	4.1	4.9	−0.6	−32.4	−1.8	8.4	1.3	3.6
4	−0.4	−10.4	−1.1	−53.6	1.7	1.8	−0.2	−53.7	−0.8	9.3	1.3	3.4
5	−0.4	−16.6	−0.7	−87.2	1.2	1.2	−0.1	−87.1	−0.6	9.5	1.4	3.2
age												
below 25	−0.9	−5.2	−5.0	−27.7	6.9	11.5	−1.0	−27.7	−2.7	7.7	0.9	4.5
25–34	−0.3	−11.9	−3.9	−29.4	4.9	6.0	−0.8	−29.4	−2.3	8.1	1.2	3.0
35–44	−0.2	−13.3	−2.3	−33.8	3.0	3.3	−0.4	−33.8	−1.4	8.8	1.3	3.0
45–54	−0.6	−10.7	−2.0	−30.4	3.0	3.4	−0.4	−30.4	−1.3	8.8	1.4	4.3
55–64	−1.6	−7.0	−1.8	−35.3	3.8	5.4	−0.4	−35.3	−1.5	8.6	1.4	8.2
all males	−0.6	−7.3	−3.2	−29.9	4.4	5.7	−0.6	−29.9	−2.2	8.0	1.2	3.8
females												
education level												
1	−2.2	−3.8	−1.4	−21.1	6.2	26.5	−2.6	−21.0	−1.4	8.6	0.9	21.1
2	−2.9	−6.3	−1.5	−25.7	7.2	19.6	−2.7	−25.7	−1.3	8.7	1.5	17.7
3	−3.5	−9.0	−1.2	−31.2	6.7	13.1	−2.1	−31.2	−1.1	8.9	2.0	15.6
4	−3.8	−11.7	−0.8	−36.8	6.0	9.7	−1.4	−36.8	−1.2	8.8	2.4	14.4
5	−2.7	−18.1	0.0	2.0	2.7	3.2	0.0	2.2	−0.7	9.3	2.7	9.3
age												
below 25	−2.0	−7.0	−1.8	−26.1	7.0	13.3	−3.2	−26.1	−1.5	8.5	1.6	10.4
25–34	−3.1	−7.6	−1.4	−27.0	7.1	15.8	−2.4	−27.0	−1.9	8.2	1.8	15.0
35–44	−3.7	−8.4	−1.2	−27.5	7.0	15.9	−2.1	−27.5	−1.9	8.1	1.9	15.6
45–54	−4.0	−7.5	−1.2	−26.5	7.2	20.7	−2.1	−26.5	−1.9	8.2	1.7	29.2
55–64	−1.9	−2.6	−0.7	−17.0	3.9	28.4	−1.3	−17.0	−0.9	9.0	0.5	52.4
all females	−3.0	−6.5	−1.3	−25.5	6.6	16.5	−2.3	−25.6	−1.2	8.5	1.6	16.5

Explanation:

all figures refer to absolute (abs) or relative (rel) changes with respect to the actual 1984-situation
2: not participating on the labour market (state 1)
3: unemployed due to a lack of productivity (state 2)
4: employed, wage rate above the minimum level
5: employed, wage rate on or below the minimum
6: predicted before-tax wage rates, unemployed people excluded
7: predicted after-tax wage rates, unemployed people excluded
8: preferred hours, non-participants included

From columns 6 through 9 it is clear that a reduction of minimum wages has a negative impact on earned wages. Because of the progressive character of the tax system, this 'income effect' is smaller for after-tax wage rates than for before-tax wage rates. The effect is rather small, because for the largest part of the employees – those with a high enough productivity to guarantee employment in the actual 1984 situation – nothing changes if minimum wage rates change.

To analyse the consequences of a reduction of income taxes, *i.e.* a reduction of the distance between before- and after-tax wage rates, a simulation of a 10% rise of all after-tax wage rates was performed. Before-tax wage rates are not changed, apart from changes due to another minimum wage law. Before-tax minimum wage rates are reduced by 10%, so that after-tax minimum wage rates approximately remain unchanged.

Consequences of this policy change are summarised in Table 9. Again, the productivity effect strongly dominates the supply effect. The rise of after-tax wage rates results in a lower degree of non-participation (columns 2 and 3) and thus induces an increase in involuntary unemployment. But the fall in involuntary unemployment caused by the lowering of the productivity threshold (a consequence of the reduction of before-tax wage rates) is much larger. As a result, involuntary unemployment falls, though not as much as was the case for the first policy simulation. Because tax rates are reduced, earned after-tax wage rates rise, but because more people with low wage rates find a job, the rise is less than 10%. The latter argument also explains the fall in before-tax wage rates.

5 CONCLUDING REMARKS

This paper is an attempt to analyse the impact of minimum wage regulations on the Dutch labour market. The estimation results of the reduced-form model introduced in Section 2 suggest that involuntary unemployment would fall sharply if minimum wages were reduced. A large fraction of registered unemployment in The Netherlands can be explained by the gap between productivity and the minimum wage rate. A 10% reduction of before-tax minimum wage rates would lead to a 28% decrease of this kind of involuntary unemployment. This result however should be interpreted with caution, because the minimum wage rate is the only source of involuntary unemployment that is explicitly taken into account. The effect might therefore be overestimated. This raises the question whether the specification of the model is correct. Comparison of actual and simulated wage rate distributions suggests that at least one effect of minimum wage laws should have been included: the minimum wage may push up wage rates to a level slightly above the minimum.

On a more principal level, the question may be asked whether the data used can really identify the difference between voluntary and involuntary unemployment. If only data on actual wages and participation are used, it is eventually the model assumptions – about the distributions of included random variables – that identify this difference. Recently collected Dutch household data also contain information on preferred working hours and the question of whether someone is looking for a job or not. In general, doubts about the value of such data may exist, for example, because the description of the scenario under which preferred hours are given is never complete. Still it seems worthwhile to compare the estimation results of a model that does not use this information with the information or with results of a model that does use the information.

In the Section 3 model, information on preferred hours is essential. A structural labour supply equation is estimated with preferred labour supply as the endogenous variable. The main finding is the fact that labour supply is a forward bending function of the (own) wage rate, for both males and females. Moreover, the elasticity of labour market participation with respect to the level of unemployment benefits is extremely small.

In Section 4, the structural labour supply equation is combined with the wage equation from Section 2. Model simulations and sample information are compared. This 'extended' model seems to yield an overestimation of employment, probably as a consequence of too primitive a specification of labour supply. The reduced form (automatically) yields a better fit in this respect, but does not completely reproduce the sample separation between voluntary and involuntary unemployment.

Policy simulations with the extended model show that productivity (demand-side) effects on the labour market – in particular the lowering of the productivity frontier by reducing the (before-tax) minimum wage rates – tend to dominate labour supply effects.

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Summary

MINIMUM WAGE RATES AND UNEMPLOYMENT IN THE NETHERLANDS

A static limited dependent variable model is formulated to analyse the Dutch labour market from an individual's viewpoint. Results suggest that high minimum labour costs are an important source of unemployment. Secondly, the reduced-form participation equation is replaced by a neoclassical labour supply equation. Thus, also the effect of high minimum wage rates on employment through labour supply is taken into account. Supply appears to be forward bending and participation is insensitive with respect to unemployment benefits. Simulations suggest that the effect of lowering the 'productivity threshold' by reducing before-tax minimum wages dominates supply effects.